STATUS OF MINERAL RESOURCE INFORMATION FOR THE SAN FELIPE PUEBLO INDIAN RESERVATION, NEW MEXICO

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SUMMARY AND CONCLUSIONS

Known mineral resources on the San Felipe Pueblo Indian Reservation include gypsum, sand and gravel, clay, and scoria. Coal in limited quantities may occur near the southeastern boundary, and Shell Oil Corp. has leased nearly the entire reservation for petroleum and natural gas exploration. Recent exploration has proven a large uranium resource near the reservation in rock formations that also underlie Indian land.

Current mineral production is limited to gypsum; past production has included minor quantities of scoria and small amounts of sand and gravel. Gypsum will continue to be produced, and a potential exists for development of clays and scoria as well as oil, gas, and uranium.

INTRODUCTION

This report was prepared for the Bureau of Indian Affairs (BIA) by the U.S. Geological Survey (USGS) and the U.S. Bureau of Mines (USBM) under an agreement to compile and summarize available information on the geology, mineral resources, and potential for economic development of certain Indian lands. Source material included published and unpublished reports, as well as personal communications. There was no field work.

The San Felipe Pueblo Indian Reservation (Figure 1) is an irregularly shaped area of 48,930 acres, wholly within Sandoval County, New Mexico, and about 25 miles northeast of Albuquerque. The tribe owns 48,853 acres, of which 71 acres are allotted, and 6 acres are owned by non-Indian interests. Population of the reservation is about 1,350. Mineral rights are owned by the tribe, except that the State of New Mexico owns the minerals in sec. 16, T. 14 N., R. 4 E., and the United States Government holds gold, silver, and quicksilver (mercury) rights in N½ sec. 1, T. 14 N., R. 4 E.

The reservation lies between the Jemez Mountains to the north and the Sandia Mountains to the south and is drained by Arroyo Tonque and the Rio Grande. Interstate Highway 25 divides the reservation in a northeast-southwest direction, and State Highway 454 provides access from the north. Bureau of Indian Affairs improved and unimproved roads afford access to other parts of the reservation.

The Atchison, Topeka and Santa Fe Railroad passes through the reservation in a generally north-south direction and connects San Felipe Pueblo with Bernalillo and Albuquerque to the south.

According to the Department of Commerce (1970), principal cities and towns of the area include Albuquerque (population 243,751), Santa Fe (population 40,167), Bernalillo (population 2,016), San Felipe Pueblo (population 1,186), and Santo Domingo Pueblo (population 1,662).

Previous Work

The San Felipe Reservation was included in Marcou's reconnaissance geologic map of central New Mexico (1858). Anderson (1960) studied the geology and geomorphology of the Santo Domingo basin, Soister (1952) studied the geology of Santa Ana Mesa, and Stearns (1953a, 1953b, 1953c)

studied the geology of the Galisteo-Tonque area. Armstrong and others (1976), Kudo and others (1977), and Bachman and Mehnert (1978) dated the basalt unit on Santa Ana Mesa and Canjilo Hill. The San Felipe Reservation also is included in recent reports by Kelley (1977, 1978), and Kelley and Northrop (1975). Hawley and Galusha (1978) summarized previous stratigraphic studies in this area, and Baltz (1978) included this area in his report about the Rio Grande depression.

Physiography

The southwest flowing Rio Grande bisects the San Felipe Reservation. The western part of the reservation is underlain by the relatively smooth, uneroded basalt of Santa Ana Mesa, which forms cliffs along the western margin of the Rio Grande valley. Dissected Santa Fe Formation forms the eastern margin of the valley. The Santa Fe Formation in the northeastern portion of the reservation has a smooth pediment surface which dips toward the Rio Grande. South of Tonque Arroyo the Santa Fe Formation has well-dissected slopes.

GENERAL GEOLOGY

Stratigraphy

Triassic through Holocene sediments and Pliocene volcanic rocks crop out in the San Felipe Reservation (Figure 2).

Triassic Rocks

Santa Rosa Formation - The Santa Rosa Formation, approximately 200 feet thick (Kelley, 1977), is a thin- to thick-bedded, white, light gray, buff and reddish-brown sandstone with mudstone partings and conglomeratic units. Reddish-brown mudstone partings are more common in the upper part of the formation and conglomeratic lenses and beds occur near the base (Kelley and Northrop, 1975).

Chinle Formation - The Chinle Formation, approximately 1,500 feet thick (Kelley, 1977), is composed of medium to dark reddish-brown shale, siltstone and sandstone. It includes conglomeratic sandstone beds, approximately 50 feet thick, at the base, and is light reddish brown near the top of the formation (Bachman, 1975).

Jurassic Rocks

Entrada Sandstone - The Entrada Sandstone is a massive-bedded, cliff-forming, buff to tan sandstone which contains large-scale eolian cross-bedding. This unit is approximately 80 feet thick in the reservation (Kelley and Northrop, 1975).

Todilto Formation - The Todilto Formation is composed of a basal, laminated, fetid limestone, 5 to 20 feet thick, which weathers to fissile, flaggy beds, overlain by a massive, light gray to white gypsum unit with thin limestone beds and varves. The gypsum unit is up to 190 feet thick, but locally may be absent (Kelley and Northrop, 1975).

Morrison Formation - The Morrison Formation, 730 feet thick east of Tonque Arroyo, is composed of white, buff, orange, greenish-white to greenish-gray, thin to thick-bedded friable sandstone interbedded with purple, purplish-brown, light to medium gray and greenish-gray mudstone and gray to greenish-gray claystone. Mudstone is more common in the lower half of the formation, and claystone is more common in the upper half of the formation. Thin lenses and beds of conglomerate and limestone occur in the middle and upper parts of the formation (Kelley and Northrop, 1975).

Cretaceous Rocks

Dakota Sandstone - The Dakota Sandstone, between 5 and 50 feet thick in this area, is composed predominantly of well-cemented, white to light gray and buff, thin- to massive-bedded sandstone. It weathers into yellow and rusty-brown angular ledges with rough, pitted surfaces. Conglomerate beds occur in the basal part of the formation; black shale beds are concentrated in the upper part of the formation (Kelley and Northrop, 1975).

Mancos Shale - The Mancos Shale, approximately 1,500 to 1,800 feet thick in the San Felipe Reservation, is predominantly a gray to black, fissile, calcareous shale with siltstone and fine-grained sandstone laminations. The shale is locally carbonaceous, siliceous or gypsiferous. A few gray to buff and olive drab, thin- to medium-bedded sandstone units and gray and brown, concretionary, fossiliferous, impure limestone units occur in the Mancos Shale (Kelley and Northrop, 1975).

Mesaverde Formation - The Mesaverde Formation, approximately 3,000 feet thick, consists of alternating units of sandstone and shale which form parallel ridges and valleys. The sandstone units, 20 to 600 feet thick, are composed of light to greenish-gray, buff, or olive drab, thin- to thick-bedded sandstones. The shale units, 20 to 500 feet thick are gray to black and brown to olive drab. Bituminous coal occurs in the shale units (Kelley and Northrop, 1975).

Eocene and Oligocene Rocks

Galisteo, Espinaso, and Abiquiu Formations - The Galisteo and Espinaso Formations of Eocene and Oligocene age, respectively, and the Abiquiu Formation of Miocene age, crop out on the eastern edge of the geologic map, Figure 2. They are not described here because their outcrops are outside the San Felipe Pueblo Reservation. All three units probably underlie much of the reservation at depth, however, where they have been downfaulted within the Rio Grande trough.

Miocene and Pliocene Rocks

The Santa Fe and Cochiti formations comprise most of the sedimentary deposits which fill the Santo Domingo basin. Deposits which retain their original geomorphology, such as terrace and pediment gravels and recent alluvium, are excluded from these formations.

Cochiti Formation - The Cochiti Formation, between 10.4 and 2.6 million years old, is composed of poorly consolidated sediments derived

from Paleozoic rocks to the northwest and Miocene volcanic rocks to the north. It is composed of a basal silt and clay unit which includes gravel beds, a middle pink to light reddish-brown sand and gravel unit up to 450 feet thick, and an upper red sand and gravel unit up to 60 feet thick. The frequency of gravel beds increases upward in the middle unit (Manley, 1978).

Sante Fe Formation - The lithology of the Santa Fe Formation varies greatly. Much of the formation is composed of buff, tan, and reddish-brown sandstone and mudstone. Fanglomerate units are interbedded with the thin- to thick-bedded sandstone and mudstone units. The fanglomerates are thicker in the upper part of the formation, and are well exposed in the Maria Chavez Arroyo, secs. 4, 8, T. 13 N., R. SE., in the southern part of the reservation (Kelley, 1977).

Basaltic Rocks and Cinder Cones of Santa Ana Mesa - Olivine- augite basalt and associated cinder cones cap Santa Ana Mesa (Smith, Bailey and Ross, 1970). The oldest basalt on the mesa is approximately 2.5 ± 0.3 million years old (Bachman and Mehnert, 1978).

Ortiz Pediment Gravel and Surface - Ortiz pediment surfaces are erosional remnants of a widespread pediment. The gravel deposits on the pediment surfaces are up to 150 feet thick, have a caliche weathering surface, and are composed of rock fragments from nearby intrusive, sedimentary and metasedimentary rocks (Kelley and Northrop, 1975).

Plio-Pleistocene Sediments

Terrace Gravels - Terrace gravels are composed of subrounded to rounded gravel, generally derived from subjacent formations.

Recent Sediments

Alluvium - The alluvium is composed of water-deposited clay, silt, sand and gravel in stream valleys.

Structure

The San Felipe Reservation is in the central portion of the Santo Domingo basin of the Rio Grande trough. The basin is bounded by the arcuate La Bajada fault on the east, and by northerly-trending faults which dissect Santa Ana Mesa on the west. The Jemez volcanic field obscures the northern boundary of the basin.

The Santo Domingo basin is an eastward-tilted block (Baltz, 1978). Basin-filling sediments are approximately 2,500 feet thick along the western margin and approximately 5,000 feet thick along the eastern margin of the basin (Kelley, 1977, fig. 20).

MINERAL RESOURCES

Known mineral resources on the San Felipe Indian Reservation include gypsum, clay, sand and gravel, and scoria. In addition, nearly the entire reservation is under lease for oil and gas exploration, and exploration for uranium currently is in

progress adjacent to reservation boundaries. Coal, in limited quantities, may underlie one or two sections in the southeast corner of the reservation. Gold also is reported to occur in a few drainages in the southeastern part of San Felipe land, but the gold is in such minute quantity and is so finely divided that it probably is uneconomic. Past production from the reservation has included gypsum, sand and gravel, and scoria; present production is limited to gypsum.

Mineral Fuels

Coal may occur on the reservation in a few sections in the southeast corner of the reservation. Coal resources, even if they occur, would be small and probably uneconomic. Shell Oil Corp. has all but 469 acres of the reservation under lease for oil and gas, and Union Carbide Corp. is exploring for uranium on land near the reservation.

Coal

Coal occurs and has been mined at the Sloan mine, which is about 1½ miles southeast of the southeastern corner of the reservation in sec. 17, T. 13 N., R. 6 E. Also, two abandoned shafts are in sec. 19, T. 14 N., R. 6 E., about half a mile east of the reservation boundary. It is believed that the shafts were sunk to develop coal, but no information concerning the operations could be found. Coal in the general area is in the Cretaceous Mesa Verde Formation. Several coalbeds within the formation range from a few inches up to about 4 feet in thickness. According to Kelley and Northrop (1975, p. 112), several investigators have measured thicknesses of the coalbeds at the Sloan mine and found them to range between 8 and 44 inches, including shale partings. Personnel of the USBM took a coal sample at the Sloan mine in 1936 (Fieldner, Cooper, and Osgood, 1936, pp. 56, 57, 93). The thickness of the coal (Hopewell bed) was 44.5 inches, including an 8.5-inch parting between coalbeds of 21 inches and 15 inches. An analysis showed the coal to contain 19.7 percent moisture, 42.3 percent volatile matter, 41.4 percent fixed carbon, 6.6 percent ash, and 0.7 percent sulfur.

Geologic evidence indicates that the coal-bearing Mesa Verde Formation either does not underlie the reservation or underlies only a very small area near the eastern boundary. Accordingly, the prospects for development of coal on San Felipe land are remote.

Oil and Gas

Neither petroleum nor natural gas have been discovered on the San Felipe Reservation. Shell Oil Corp., however, has had an oil and gas lease on all but 469 acres since 1972. The company has not drilled on San Felipe land, but it did drill a test hole in sec. 18, T. 13 N., R. 3 E., about 8 or 10 miles west of the southwestern corner of the reservation. The hole was collared in the Tertiary Santa Fe Formation and bottomed in Precambrian crystalline rock. Total depth of the hole was 11,045 feet; drilling began in June 1972 and terminated in August of the same year. Another exploratory hole was drilled in 1976 by Colorado Plateau Geological Services, Inc., in sec. 35, T. 13 N., R. 5 E., about 3 miles south of the reservation near the

village of Placitas. The test hole was collared in Quaternary alluvium and bottomed in the Jurassic Morrison Formation. Total depth of the dry hole was 1,403 feet and, according to USGS records, it was plugged and abandoned.

Until the area is tested by drilling, the oil and gas potential on the reservation cannot be determined. No plans have been announced for such exploration in the near future.

Uranium

Uranium has not been discovered on San Felipe land, but recent exploration has proved that uranium resources are present on private land nearby. The exploration, by Union Carbide Corp., has been carried out south, east, and northeast of the reservation. Representatives of the company would not reveal the results of the exploration, but an inclined shaft was sunk in sec. 16, T. 13 N., R. 6 E. The shaft is a few miles south of a uranium anomaly in the Santa Fe Formation shown by the U.S. Atomic Energy Commission (1966) and by Hilpert (1969, p. 53). Hilpert also lists two other uranium occurrences near the Union Carbide shaft. The first is in the Mesa Verde Formation in S½ sec. 6, T. 13 N., R. 6 E., and the second is in the Santa Fe Formation in sec. 10, T. 14 N., R. 6 E. A Department of Energy (DOE) representative was of the opinion that results of the exploration indicated that no mining would be undertaken in the near future; however, a company representative said that exploration in the area would continue.

The prime target for uranium exploration in the general vicinity of the San Felipe Reservation is the Eocene Galisteo Formation. According to personnel of the USGS and DOE, the Miocene Santa Fe Formation, which is thought to have a high potential for uranium in other areas, does not have a high potential in the San Felipe area. Probable reasons for this belief are the lack of known occurrences in the formation and the lack of verified uranium-bearing source rocks in the San Felipe area.

The Santa Fe and Galisteo Formations underlie most of the reservation, and it is possible that uranium resources are present in either or both formations.

Metallic Mineral Resources

Gold is the only metallic mineral found on San Felipe land, occurring in gravels of several drainages from the Ortiz and San Pedro Mountains southeast of the reservation. Because the gold is found only in minor quantities and in finely divided form, it probably could not be recovered economically. Lindgren (1910, p. 174) describes the gold in gravels of streams emanating near the San Pedro Mountains, as follows:

> "As the erosion of the San Pedro Mountains has proceeded, apparently without check, since the middle or beginning of the Tertiary, it is not surprising to find great detritus fans extending from every gulch and gradually flattening out as they merge into the gravel-covered plains; the characteristic detritus of porphyry and lime extends for miles in every direction, particularly westward along Tuerto Creek. All of this subangular gravel contains gold, and

every creek and gulch cutting into it has concentrated the gold farther along its course."

Although Tuerto Creek itself does not cross San Felipe land, its drainage system does. The gold, if present, would occur in gravels of the Tonque Arroyo and the Arroyo Una del Gato. Any gold in the two drainages on the reservation, however, would be about 60 miles from its source, finely divided, and therefore probably uneconomic to mine.

Nonmetallic Mineral Resources

Nonmetallic mineral production from the reservation has been limited to gypsum, scoria, and sand and gravel. Clays are known to occur, but no production has been recorded.

Gypsum

The only current mineral activity on San Felipe land is gypsum mining by the Ernest Teeter Co. The mine is in sec. 1, T. 13 N., R. 5 E. (Figure 1). Production was 23,185 tons in 1978. The gypsum is used for cement manufacture at the Ideal Cement Co. plant at Tijeras, a few miles east of Albuquerque. The tribe received a one-time payment of $1,000 in January 1979 and will receive a $.30-per-ton royalty for the entire 10-year lease period. Reserves are large and at the present rate of production should be a source of income to the tribe for many years. According to BIA records, the lease is for 15 acres, but at present only about 3 to 4 acres of land has been disturbed.

The mine is in a deposit of massive gypsum in the Jurassic Todilto Formation. The bed is about 40 feet thick at the mine site, but Weber and Kottlowski (1959, p. 22) state that the gypsum attains a thickness of 88 feet in the general area.

The mine is an open-pit operation that requires removal of up to 4 feet of unconsolidated overburden before drilling, blasting, and loading of the gypsum.

Scoria

Scoria has been mined on the reservation on Santa Ana Mesa in sec. 24, T. 14 N., R. 4 E., where about 1 acre was disturbed. Royalty paid to the tribe and the quantity of material removed are unknown, but the pit is small and shallow, indicating that production was small. Other deposits may occur in the general area.

Sand and Gravel

Sand and gravel occurs on the San Felipe reservation but has been produced in only limited quantity. One small operation in NW¼ sec. 8, T. 14 N., R. 5 E., (Figure 1) evidently yielded sand and gravel for use on the reservation. Other sand and gravel deposits occur along the Rio Grande; the quantity is unknown, but reserves may be substantial.

Clay

Clay has been mined from the Tonque pit, in Mancos Shale, adjacent to the southeast corner of the reservation in NW¼ sec. 18, T. 13 N., R. 6 E.

According to Hawks (1970, p. 15), the clay was mined by the Albuquerque Brick and Tile Co. and was used to manufacture bricks until 1953 when the plant shut down. In the Tonque area, clay materials occur in both the Mancos Shale and the Chinle Formation. Leland (1966, p. 2) recommended that:

> "serious consideration be given the Tonque area as a source of raw material for a brick plant to serve the Albuquerque and Santa Fe markets."

Hawks (1970) stated that the Mancos Shale in the Tonque area shows promise of economic development. Both Kelley (1963) and Leland (1966, fig. 6) show Mancos Shale cropping out on Indian land in a narrow band along the east side of sec. 12, T. 13 N., R. 5 E., and Leland shows it cropping out along the east side of sec. 1. Mineral rights in these areas are held by the Indians. Other mineral rights in the Tonque area, outside the reservation, were held by private entities and by the U.S. Bureau of Land Management as of 1966. If clay exploitation of any consequence should develop, the San Felipe tribe could well be a participant in the general development of the area.

MAP COVERAGE

The USGS has published 7.5- and 15-minute topographic quadrangle maps covering the entire reservation. Applicable maps in these series are:

7.5-Minute Maps

Bernalillo	San Felipe Pueblo NE
Placitas	Santa Ana
San Felipe	Pueblo

15-Minute Maps

San Felipe

The USGS has also published two geological maps of the area: a State geological map covering the entire area and a geologic map of the Jemez Mountains covering the western part of the reservation.

In addition to the topographic and geologic maps listed, the USGS has published a State of New Mexico base map. All listed maps may be ordered from the U.S. Geological Survey, Branch of Distribution, Central Region, Box 25286, Denver, Colorado 80225.

Another source of map coverage is the U.S. Bureau of Land Management, which has published Master Title Plats covering each township as well as surface management maps. Both the plats and maps can be ordered from the Bureau of Land Management, Records Section, P.O. Box 1449, Santa Fe, N. Mex. 87501. An historical index of the Master Title Plats can also be obtained. The quadrangles, Master Title Plats, and historical indexes should be ordered by township and range.

The New Mexico State Highway Department has county road maps available. Requests should be addressed to the New Mexico State Highway Department, Duplicating Services, P.O. Box 1149, Santa Fe, N. Mex. 87503. The New Mexico State Bureau of Mines in Socorro is also a source of map information.

Aerial photographs of the reservation may be purchased from both the USGS and the U.S. Department of Agriculture. Agencies within the Department of Agriculture from which photos may be obtained are the U.S. Forest Service and the U.S. Soil Conversation Service. Satellite imagery can be obtained from the U.S. Geological Survey, EROS Data Center, Sioux Falls, S. Dak. 57101.

RECOMMENDATIONS FOR FUTURE WORK

Actions that the San Felipe tribe might consider to promote the development of mineral resources within reservation boundaries are:

1. Interest private industry in uranium exploration.
2. Investigate the clay potential of the Tonque area.
3. Investigate the Santa Ana Mesa to determine the extent of scoria resources.

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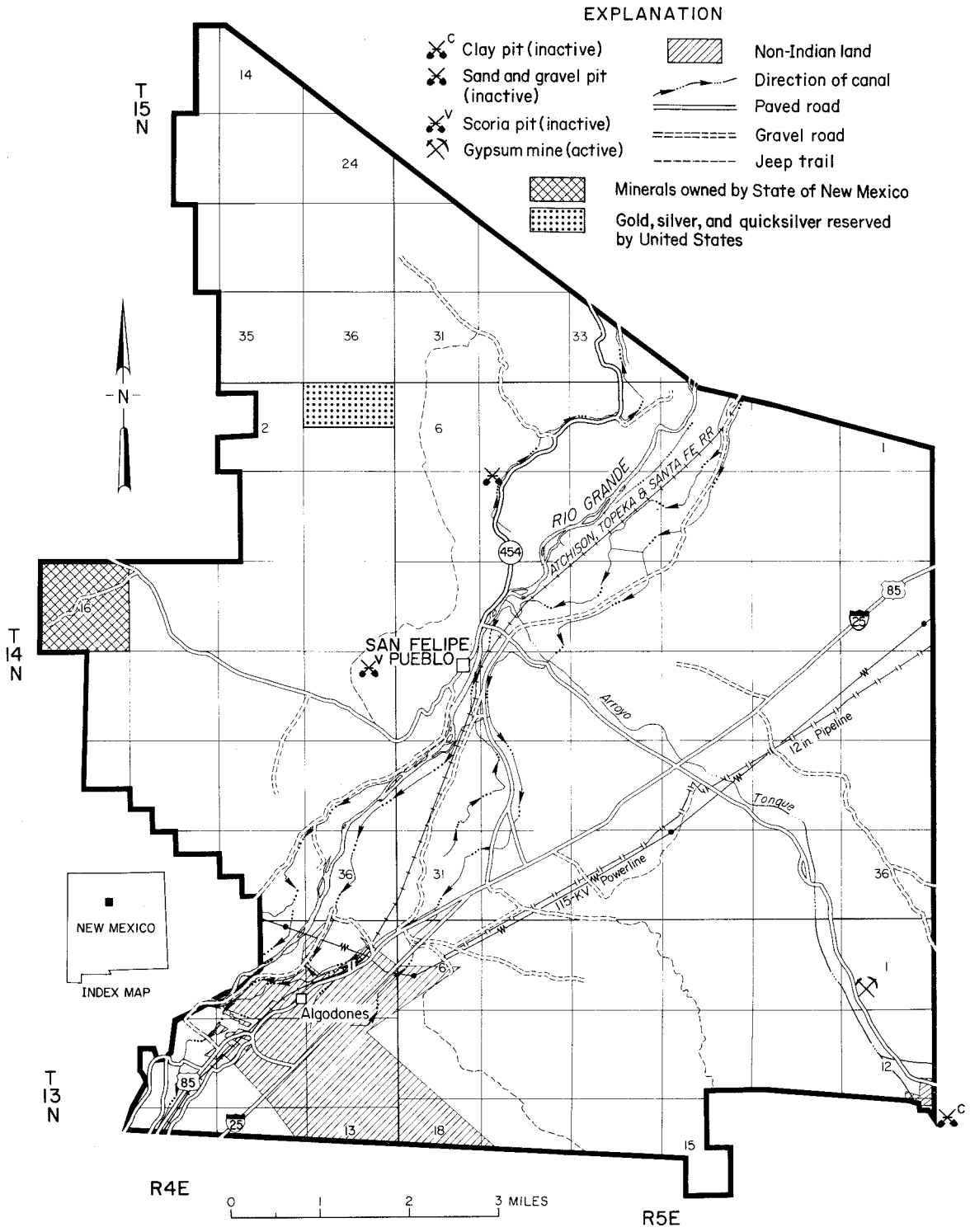

Figure 1. Map of the San Felipe Pueblo Indian Reservation, Sandoval County, NM.

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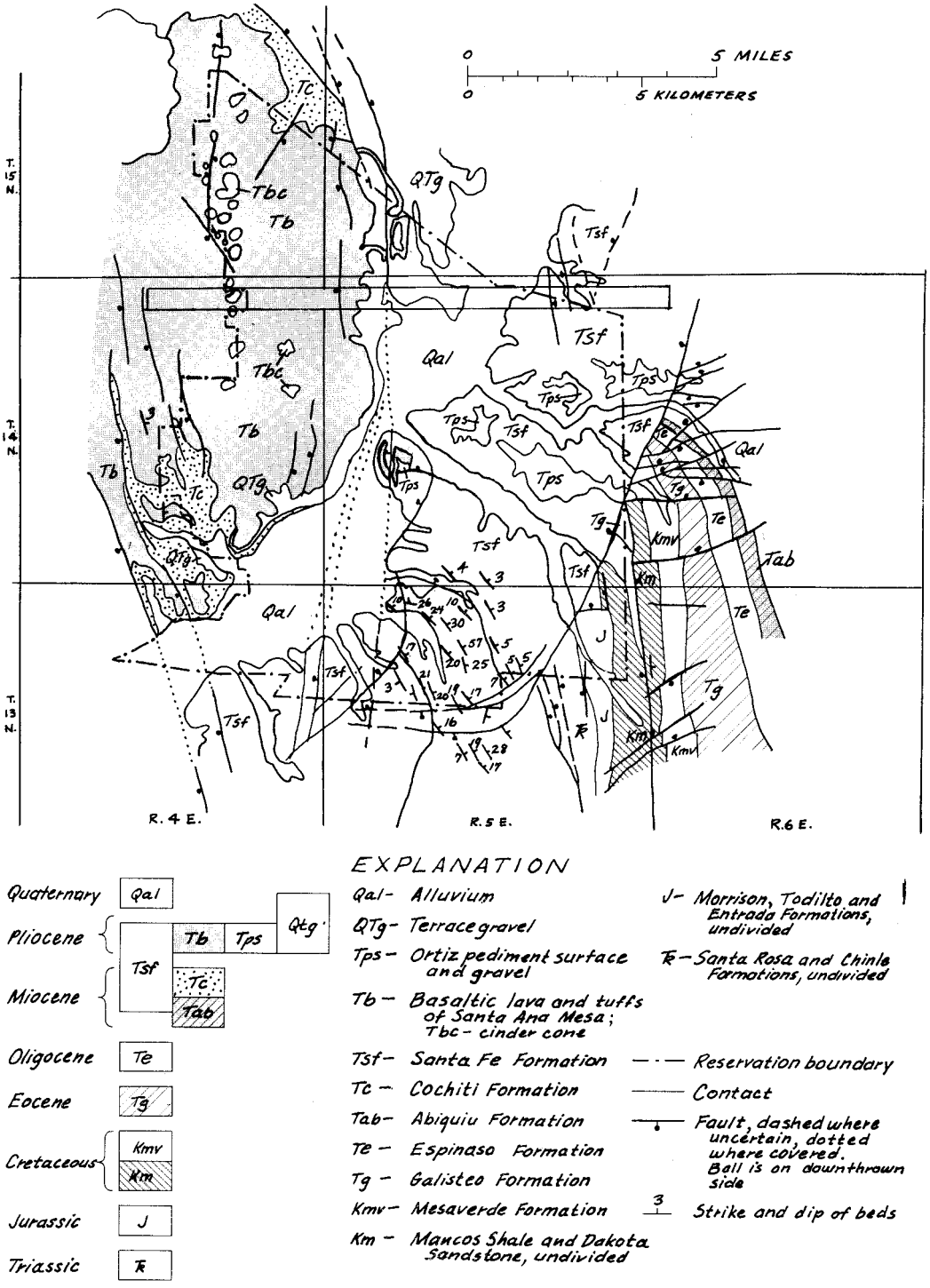

Figure 2. Geologic map of the San Felipe Reservation (modified from Kelly, 1977, and Wyant and Olson, unpublished map).